

Office of Environmental Management – Grand Junction



Environmental Air Monitoring Data Quarterly Report for the Moab, Utah, Site

**Fourth Quarter 2005
(October through December 2005)**

May 2006



**U.S. Department
of Energy**

Office of Environmental Management

Moab, Utah
Environmental Air Monitoring Results
October - December 2005

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Summary of Results

Site: Moab, Utah

Sampling Period: October through December 2005

Atmospheric Radon-222: U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a guideline for atmospheric emissions of radon-222 gas that is applicable to the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Site (Moab Site). This guideline is 3.0 picocuries per liter (pCi/L) above background. Background concentrations of radon-222 in the Moab area have been measured at 0.7 pCi/L; based on 3 years of data from 2003 to 2005, therefore, the guideline for radon-222 emissions at the Moab Site for this sampling period is 3.7 pCi/L. Monitoring data collected during the fourth quarter of 2005 indicate that this guideline was equaled or exceeded at seven on-site monitoring locations and one off-site radon monitoring location (0126-Rn). These higher than normal radon values are probably the result of very stable atmospheric conditions that persisted during the monitoring period. Please refer to [Tables 1](#) and [2](#) for a review of all data.

Direct Environmental Gamma Radiation: DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a dose limit of 100 millirem per year (mrem/yr) above naturally occurring gamma levels (background). Background gamma radiation for the Moab area has been measured at 82 mrem/yr; therefore, the gamma dose limit for the Moab Site is 182 mrem/yr. Although radiation doses are summed at the end of a calendar year to determine the actual annual dose, the annual dose may be *estimated* from the quarterly monitoring results. Based on the monitoring data collected from the fourth quarter of 2005, nine on-site monitoring locations exceeded the gamma dose limit, while none of the off-site monitoring locations exceeded the gamma radiation dose limit. Please refer to [Tables 1](#) and [2](#) for a review of all data.

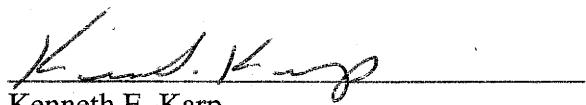
It should be noted that, although the exposure rates may be exceeded at several locations along the DOE site property boundary, this does not reflect expected doses to the public. These data represent the dose that a member of the public could receive if that person resided at the point where the data were collected for an entire year. This is not a realistic representation of actual or expected public exposure conditions because no member of the public permanently resides at or near these locations of elevated readings. Monitoring data observed at the maximum exposed individual (MEI) location, just east of the Moab site, represents the greatest potential exposure to a member of the public. The gamma radiation dose measured at the MEI was 65 mrem/yr.

Radioparticulates: No standards or radiological exposure limits were exceeded at any of the nine radioparticulate monitoring locations during the current monitoring period. Analytical data for all analytes (radium-226, thorium-230, polonium-210, and uranium-total) were below their respective Derived Concentration Guidelines (DCGs), as found in DOE Order 5400.5, *Radiation Protection of the Public and Environment* (Table 3). Concentrations of the radioparticulates have been consistently below DCGs since DOE took ownership of the site in 2001. DOE Order 5400.5 also requires that the individual dose resulting from airborne emissions be less than 10 mrem/yr. All off-site sampling location concentrations, when converted to dose, were indistinguishable from the average background value of 0.3 mrem/yr. The maximum on-site dose resulting from airborne emissions (station 0105) including

background was 0.7 mrem/yr. Measured dose at the other on-site location (station 0102) was equivalent to background.

Table 1. Moab Environmental Air Monitoring Locations with Samples that Exceeded Applicable Regulatory Standards, Limits, or Guidelines During the Fourth Quarter, 2005

Analyte	Standard / Guideline	Sampling Locations Exceeding Standards/Guidelines
Radon-222	3.7 pCi/L	0101, 0104, 0105, 0106, 0107, 0108, 0113, 0126
Direct Gamma Radiation	191 mrem/yr	0101, 0105, 0106, 0107, 0108, 0109, 0110, 0111, 0113


Kenneth E. Karp
Moab Project Manager

5-1-06
Date

Data Assessment

Environmental Air Monitoring Field Activities Verification Checklist

Project	Moab, Utah	Date(s) of Water Sampling	October through December 2005
Date(s) of Verification	April 19, 2006	Name of Verifier	Jeff Price
		Response (Yes, No, NA)	Comments
1.	Is the SAP the primary document directing field procedures?	Yes	
2.	Were the sampling locations specified in the SAP?	Yes	
3.	Were low-volume air samplers operating at or near 60 liters/minute?	Yes	
	Did any of the samplers require air flow adjustment?	Yes	
4.	Were detectors (radon cups, TLDs) and monitoring equipment found to be in undisturbed and operable condition upon arrival?	Yes	
5.	Were the hourly clocks on the low-volume air samplers operational upon arrival?	Yes	
	Were the run times recorded for each radioparticulate monitoring location?	Yes	
6.	Were duplicates (for radon and gamma radiation) taken at a frequency of one per 20 samples?	Yes	
7.	Were equipment blanks (for radioparticulates) taken at a frequency of one per 20 samples?	No	Not required. Concentration of uranium slightly above detection; contribution of uranium in filter matrix will be negated when subtracting background concentrations.
8.	Were trip blanks (for radon and gamma radiation) included with each shipment?	Yes	
9.	Was the identity of the QC sample locations protected?	Yes	
10.	Were the true locations of the QC samples recorded in the Field Log Book?	Yes	
11.	Were all samples collected as specified in the SAP?	Yes	
12.	Were chain of custody records completed and was sample custody maintained?	Yes	
13.	Are field data sheets signed and dated by sampling personnel?	Yes	
14.	Was all other pertinent information documented on the field data sheets?	Yes	

Data Assessment Summary

Atmospheric Radon-222 Analyses

Radon cups were analyzed by Landauer Inc. in accordance with Landauer's *Quality Assurance Manual for Radon Monitoring Services Revision Number 9, October 17, 2002*. Fourth quarter 2005 analytical radon data were received in a report dated January, 2006. Unlike radioparticulate analyses, radon-222 data are not reported with qualifiers. The laboratory will make a special note/comment in the event that the detectors are missing, damaged, or the detectors cannot be read. Once the data report is received, sampling personnel review all data to insure that the results are consistent with other data points as well as with previous data collected for each monitoring location. Data reports are checked to verify that the reported concentrations/results are correct.

Direct Environmental Gamma Radiation Analyses

Thermoluminescent dosimeters (TLDs), used for continuous dose measurements at the Moab Site, are analyzed by Environmental, Inc., Midwest Laboratory, in accordance with their analytical procedure *Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01, Revision 6* (Teledyne Isotopes 1995). Fourth quarter 2005 environmental gamma radiation data were received in a report dated January 17, 2006. All data are reported at the 95% confidence level (2 sigma). Once the data report is received, sampling personnel review all data to ensure that the results are consistent with other data points as well as with previous data collected for each monitoring location. Data reports are checked to verify that the reported concentrations/results are correct.

Radioparticulate Analyses

All radioparticulate samples were analyzed by Severn Trent Laboratories (STL)-St. Louis, Missouri. Radioparticulate samples for the fourth quarter of 2005 were sent to STL for analysis on January 17, 2006.

STL analyzed the glass fiber (47 mm) air filters for radioparticulates (radium-226, thorium-230, polonium-210, and uranium-total). Analytical results for the fourth quarter 2005 sampling period are reported by STL in Report Identification Number (RIN) 06010293. Polonium-210 and thorium-230 were analyzed by alpha spectrometry, STL methods STL-RC-0210 and EML A-01-R MOD, respectively. Radium-226 was analyzed by gas proportional counting, STL method EML RA-06-RC MO. Total uranium was analyzed by inductively coupled plasma-mass spectrometry, EPA method SW-846 6020. Radioparticulate analytical data for samples collected during the fourth quarter of 2005 were reviewed, validated, and summarized in the *Data Review and Validation Report for RIN 06010293* (February 27, 2006), which was prepared and issued by the Grand Junction Site laboratory and sample coordinator.

Field Activities

Duplicate samples are collected for direct gamma environmental radiation at three locations: (1) 0117, an off-site, background monitoring site, with consistently low readings; (2) 0107, an on-site location with consistently elevated readings; and (3) 0127, an off-site location that is immediately up-wind of the city of Moab, and is directly south of the Moab Site. Duplicate samples for radon-222 monitoring are collected only at the MEI location. The MEI is located immediately east of the Moab Site property boundary and represents the worst-case exposure scenario to a member of the public.

Duplicate samples are not collected for radioparticulate samples. Because the radioparticulate sample data collected to date indicate that all of the isotopes are several orders of magnitude below their respective DCGs, the costs associated with purchasing a duplicate sampler, providing additional electrical power, and incurring additional analytical expenses were not justified.

Suspected Anomalies

All analytical data are reviewed for anomalous or outlying data points. This review consists of evaluating monitoring data against historical and minimum/maximum values to determine if the reported data are within reasonable expected ranges. Because there are relatively few sample locations (i.e., data points), and the historical data set is relatively short, this review is currently conducted manually. An automated review of reported analytical data against historical and minimum/maximum values may be initiated at some point in the future once it is determined that the data set has become too large or cumbersome for an accurate manual review. Based upon a review of the monitoring data collected during the fourth quarter of 2005, there were no anomalous data identified.

Summary

Data collected during the fourth quarter of 2005 met the applicable laboratory control criteria for their respective analyses, and all data were reviewed by qualified personnel and found to be within the acceptable limits of counting error associated with each matrix. Data reported in this environmental air monitoring report are considered validated and may be treated as final results.

Kend Kuykendall

Jeff Price
Environmental Scientist

5-1-06

Date

Environmental Air Monitoring Data

Environmental Air Monitoring Data Summary

This section contains data summary tables for each of the environmental air monitoring matrixes. Radon and direct gamma radiation are summarized in [Table 2](#); radioparticulate data are summarized in [Table 3](#). Each data table also displays monitoring data collected during the previous quarters for the calendar year.

Time versus concentration graphs have also been prepared for each matrix. Concentrations over time have been plotted only for selected locations for each matrix. The rationale used for selecting each location is summarized below.

Radon-222

Radon-222 monitoring data have been graphed ([Figure 5](#)) for the following locations.

(1) Location MEI is considered to represent the worst-case exposure scenario to a member of the public. (2) Location 0107 is located on the southern property boundary of the Moab Site and has historically recorded some of the highest radon exposure readings. (3) Location 0117 (near the Bar-M Chuckwagon) is a background monitoring location located approximately five miles north of the Moab Site property and represents background conditions. (4) Location 0120 (near the Portal RV Park) is approximately one mile southeast of the Moab Site and represents the second greatest risk (second to the MEI location) for off-site exposure.

Direct Gamma Radiation

Gamma radiation data have been graphed for the following locations. (1) Location MEI is considered to represent the worst-case exposure scenario to a member of the public. (2) Location 0107 is on the southern property boundary of the Moab Site and has historically recorded some of the highest gamma radiation exposure readings. (3) Location 0117 (near the Bar-M Chuckwagon) is a background monitoring location approximately five miles north of the Moab Site property. (4) Location 0120 (near the Portal RV Park) is approximately one mile southeast of the Moab Site and represents the second greatest risk (second to the MEI location) for off-site exposure.

Radioparticulates

Radioparticulate monitoring data have been graphed for the following locations. (1) Location 0102, one of two on-site radioparticulate monitoring locations, is the radioparticulate sampling location closest to the MEI, and provides useful information regarding the MEI's exposure to radioparticulate matter. (2) Location 0105, the other on-site continuous radioparticulate sampler located on the bank of the Colorado River, is the location closest to the emissions source (i.e., the mill tailings pile). Location 0105 is at the site boundary adjacent to the Colorado River and the Matheson Wetlands Preserve. (3) Location 0117 (near the Bar-M Chuckwagon) is a background monitoring location approximately 5 miles north of the Moab Site property and represents ambient or naturally occurring conditions. (4) Location 0120 (near the Portal RV Park) is approximately one mile southeast of the Moab Site and represents the second greatest risk (second to the MEI location) for off-site exposure.

Table 2. Summary of Environmental Radon and Gamma Radiation Monitoring Data for the Moab Site for Calendar Year 2005

Station Number	1st Quarter 2005 (01/18/05 - 04/06/05)		2nd Quarter 2005 (04/06/05 - 07/11/05)		3rd Quarter 2005 (07/11/05 - 11/08/05)		4th Quarter 2005 (11/08/05 – 01/04/06)		2005 Annual Average	
	Radon pCi/L	Gamma mrem/91 d ³	Radon pCi/L	Gamma mrem/yr						
On-Site Locations										
0101	2.2	72.5	2.1	64.8	3.0	65.9	4.1	59.6	2.8	263
0102	1.6	23.6	1.3	24.2	1.3	25.0	1.9	28.9	1.5	102
0103	1.4	24.5	1.3	24.2	1.4	26.1	2.6	28.5	1.7	103
0104	1.6	30.6	1.6	26.5	2.0	26.8	3.6	28.6	2.2	112
0105	2.2	46.1	2.1	49.1	2.9	49.9	5.1	54.8	3.1	200
0106	5.8	39.7	5.3	41.2	7.6	43.4	11.5	48.6	7.6	173
0107	2.2	49.2	4.3	58.0	5.2	57.5	10.6	66	5.6	231
0108	2.7	117.4	4.7	139.4	5.0	131.9	6.0	136.4	4.6	525
0109	1.7	51.3	1.8	59.4	2.3	55.7	2.1	60.3	2.0	227
0110	1.4	81.2	3.4	89.6	2.3	89.7	1.9	89.5	2.2	350
0111	0.6	63.7	1.3	NDA	1.0	71.5	0.8	63.7	0.9	265
0112	1.3	37.3	1.9	38.1	2.3	42.3	2.1	39	1.9	157
0113	1.7	79.6	2.4	74.6	2.8	73.6	3.6	81.5	2.6	309
Off-Site Locations										
0117 ¹	0.7	21.1	0.7	24.4	0.8	23.5	0.8	26	0.8	95
0118	0.5	15.1	0.8	18.9	0.9	17.3	0.8	22.1	0.8	73
0119	0.6	21.6	1.0	26.0	1.0	25.3	1.7	28.9	1.1	102
0120	0.4	16.6	0.7	25.1	0.9	19.9	0.9	22.9	0.7	84
0121	0.4	19.2	0.6	21.8	0.9	21.3	0.8	22.7	0.7	85
0122	0.4	16.4	0.6	19.1	0.5	19.0	<0.5	20.4	0.5	75
0123 ¹	0.4	18.0	0.4	18.3	0.6	20.4	<0.5	19.2	0.5	76
0124	0.8	18.8	NDA	23.9	1.4	22.2	1.9	27.4	1.4	92
0125	0.9	23.1	1.5	25.4	2	25.4	2.7	28.4	1.8	102
0126	0.9	20.4	1.7	24.5	2	23.2	4.0	26.5	2.2	95
0127	0.4	17.8	0.8	25.8	1.1	21.2	1.8	28.9	1.0	94
MEI ²	1.2 dup	14.2	0.8 dup	16.3	1.5 dup	19.2	2.3 dup	16.1	1.5	66

¹ Designated background monitoring locations. Background locations are located at sufficient distances away from the millsite to be free from any affects or influences from potential site contaminants.

² The maximally exposed individual (MEI) is the continually occupied residential property that is closest to the DOE property boundary.

³ mrem value is prorated to a 91 day exposure period.

NA = Not Applicable.

NDA = No Data Available.

Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for Calendar Year 2005

Station Number	Isotope	First Quarter 2005 ($\mu\text{Ci}/\text{mL}$) ⁵	Second Quarter 2005 ($\mu\text{Ci}/\text{mL}$)	Third Quarter 2005 ($\mu\text{Ci}/\text{mL}$)	Fourth Quarter 2005 ($\mu\text{Ci}/\text{mL}$)	Annual Average ($\mu\text{Ci}/\text{mL}$)
On-Site Locations						
0102-RP	Uranium ¹	7.5E-17	1.6E-16	2.0E-17	7.8E-17	8.4E-17
	Thorium-230 ²	5.6E-17	1.3E-16	1.4E-16	6.1E-17	9.6E-17
	Radium-226 ³	1.3E-16	9.9E-17	2.4E-16	2.6E-16	1.8E-16
	Polonium-210 ⁴	1.1E-14	1.6E-15	3.2E-15	4.2E-16	4.0E-15
0105-RP	Uranium ¹	1.6E-16	3.0E-16	3.2E-16	1.8E-16	2.4E-16
	Thorium-230 ²	6.3E-17	2.8E-16	7.9E-16	2.2E-16	3.4E-16
	Radium-226 ³	1.3E-16	9.7E-17	2.2E-16	2.7E-16	1.8E-16
	Polonium-210 ⁴	9.9E-15	2.4E-15	7.9E-15	1.1E-15	5.3E-15
Off-Site Locations						
0117-RP	Uranium ¹	1.4E-17	2.5E-17	8.6E-18	1.8E-17	1.6E-17
	Thorium-230 ²	2.8E-17	7.6E-17	1.0E-16	7.6E-17	7.1E-17
	Radium-226 ³	1.3E-16	6.4E-17	2.9E-16	2.9E-16	1.9E-16
	Polonium-210 ⁴	5.0E-15	2.9E-15	5.6E-15	8.2E-16	3.6E-15
0118-RP	Uranium ¹	2.3E-17	3.2E-17	1.1E-17	2.3E-17	2.2E-17
	Thorium-230 ²	5.2E-17	1.4E-16	8.3E-17	8.1E-17	8.8E-17
	Radium-226 ³	2.0E-16	2.0E-17	2.9E-16	2.1E-16	1.8E-16
	Polonium-210 ⁴	6.6E-15	2.5E-15	4.7E-15	7.5E-16	3.6E-15
0119-RP	Uranium ¹	2.3E-17	9.4E-17	2.8E-17	2.9E-17	4.4E-17
	Thorium-230 ²	4.5E-17	1.6E-16	1.2E-16	7.0E-17	1.0E-16
	Radium-226 ³	1.4E-16	5.4E-17	1.8E-16	2.3E-16	1.5E-16
	Polonium-210 ⁴	6.8E-15	3.2E-15	5.6E-15	7.4E-16	4.1E-15
0120-RP	Uranium ¹	1.5E-17	2.1E-17	1.6E-17	2.4E-17	1.9E-17
	Thorium-230 ²	4.7E-17	1.5E-16	7.1E-17	5.0E-17	8.0E-17
	Radium-226 ³	1.2E-16	2.8E-17	3.3E-16	1.9E-16	1.7E-16
	Polonium-210 ⁴	4.3E-15	1.7E-15	4.9E-15	9.7E-16	3.0E-15
0121-RP	Uranium ¹	1.8E-17	1.8E-17	2.2E-17	2.1E-17	2.0E-17
	Thorium-230 ²	1.8E-17	1.2E-16	1.6E-16	7.0E-17	9.3E-17
	Radium-226 ³	1.4E-16	9.0E-18	2.3E-16	1.8E-16	1.4E-16
	Polonium-210 ⁴	5.9E-15	1.6E-15	4.9E-15	7.3E-16	3.3E-15
0122-RP	Uranium ¹	1.5E-17	1.9E-17	9.7E-18	2.4E-17	1.7E-17
	Thorium-230 ²	2.2E-17	2.4E-16	8.1E-17	6.1E-17	1.0E-16
	Radium-226 ³	1.7E-16	3.0E-17	2.0E-16	2.4E-16	1.6E-16
	Polonium-210 ⁴	3.4E-15	1.7E-15	3.8E-15	1.1E-15	2.5E-15
0123-RP	Uranium ¹	1.6E-17	2.4E-17	9.5E-18	1.7E-17	1.7E-17
	Thorium-230 ²	3.7E-17	7.7E-17	1.5E-16	4.5E-17	7.7E-17
	Radium-226 ³	1.7E-16	2.8E-17	2.0E-16	2.9E-16	1.7E-16
	Polonium-210 ⁴	7.5E-15	2.7E-15	5.2E-15	1.0E-15	4.1E-15

¹DOE DCG for Total Uranium = 2.E-12

²DOE DCG for Thorium-230 = 4.E-14

⁵ $\mu\text{Ci}/\text{mL}$ = microCuries per milliliter

³DOE DCG for Radium-226 = 1.E-12

⁴DOE DCG for Polonium-210 = 1.E-12

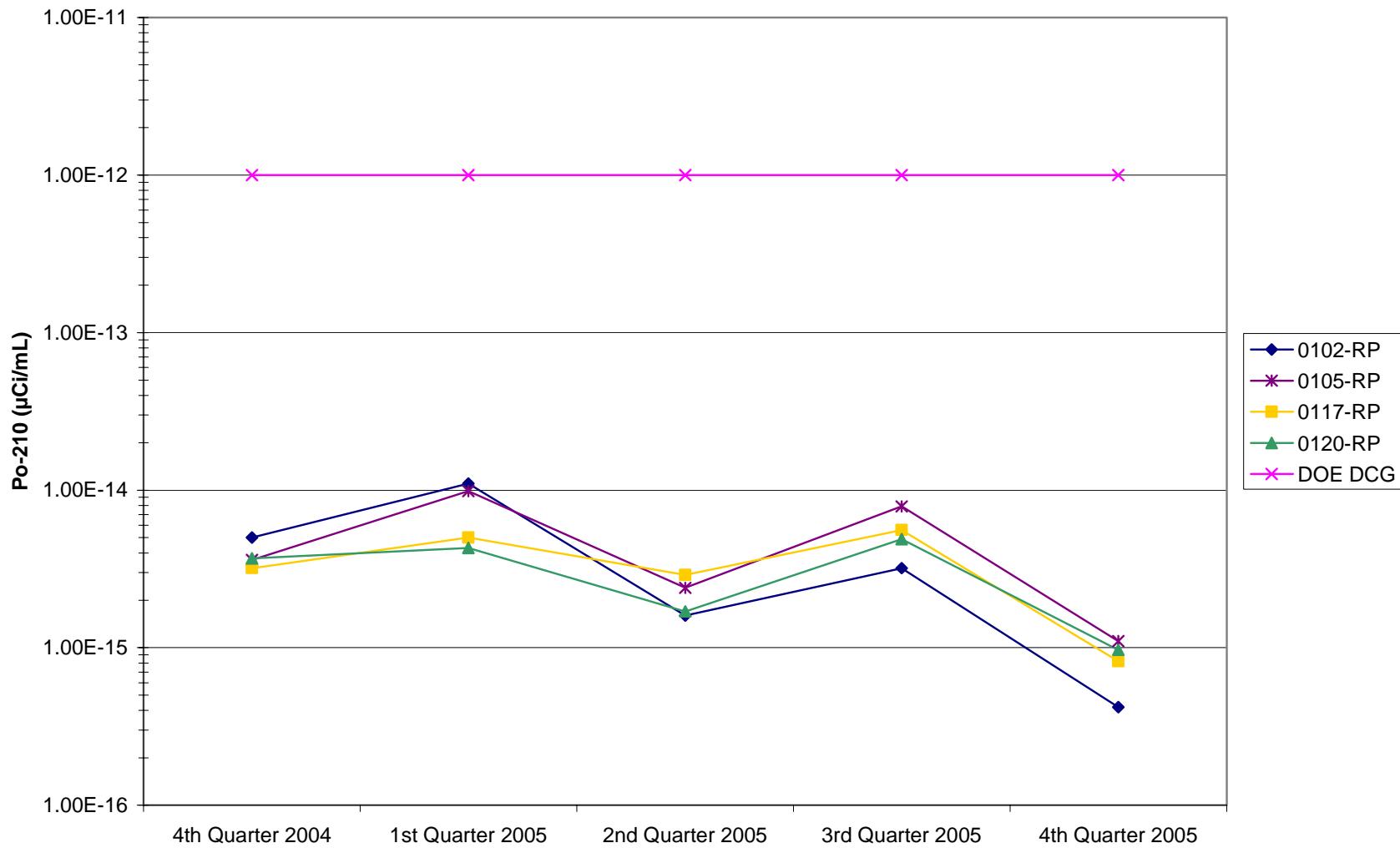


Figure 1. Moab Radioparticulate Concentration (Po-210)

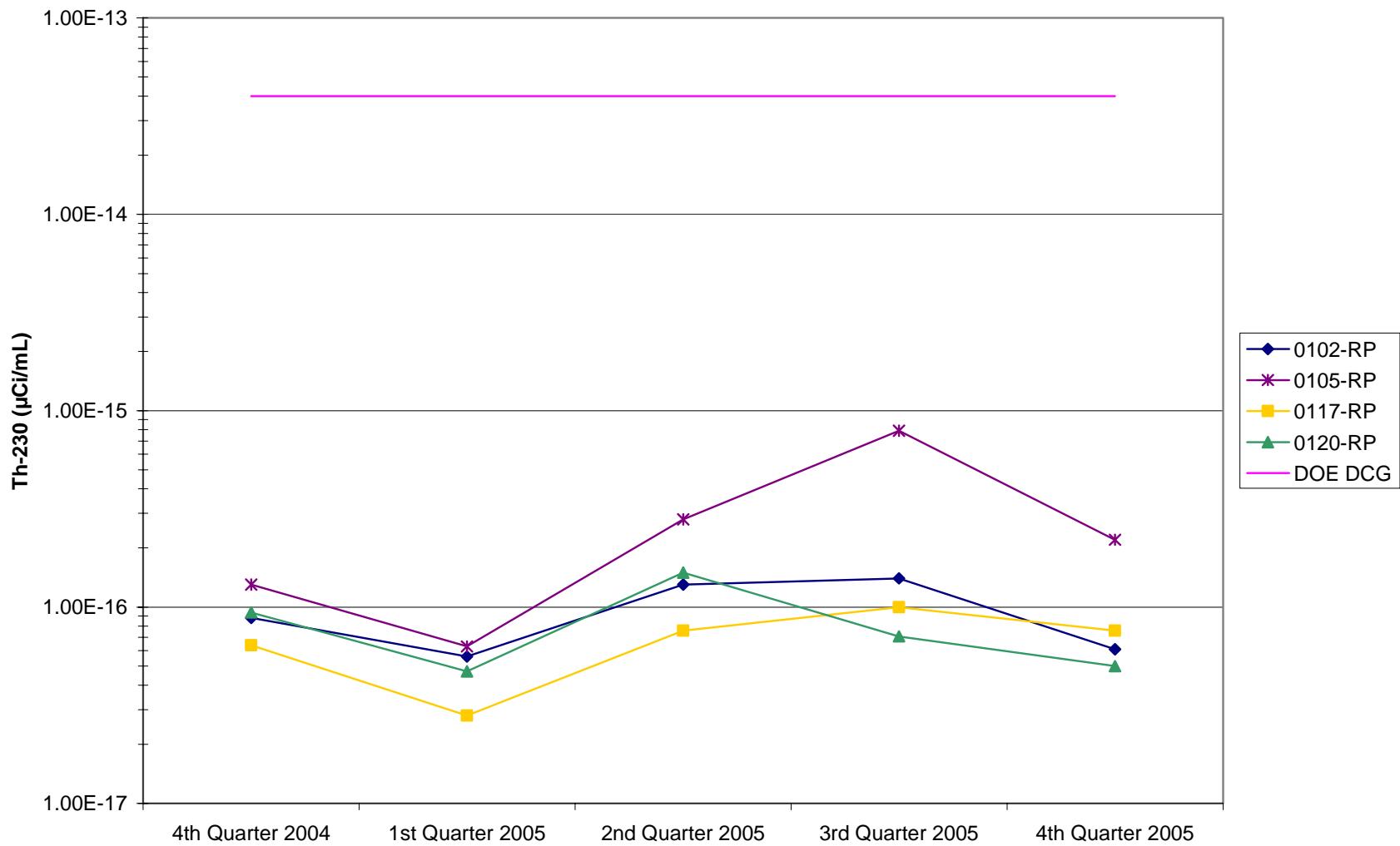


Figure 2. Moab Radioparticulate Concentration (Th-230)

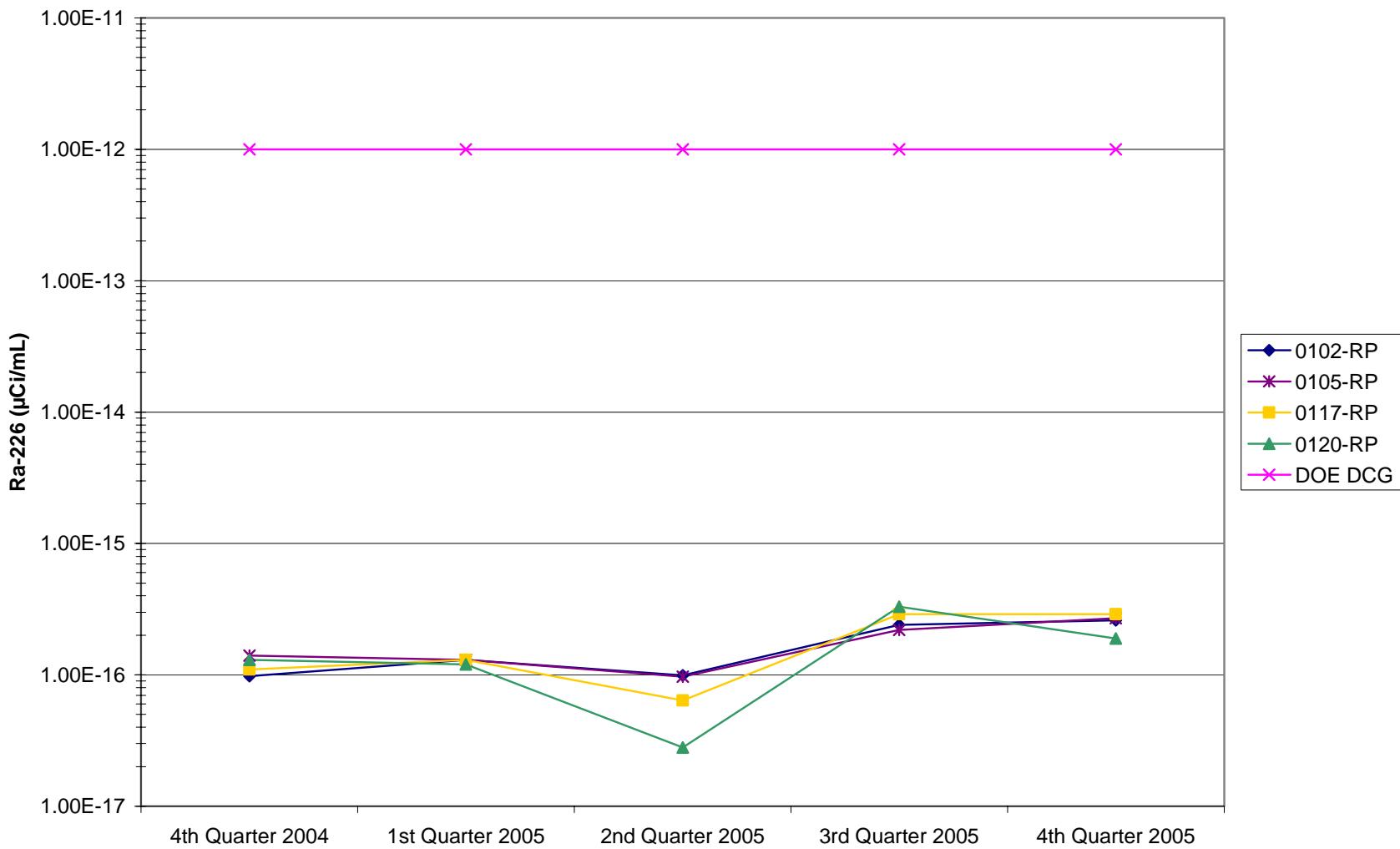


Figure 3. Moab Radioparticulate Concentration (Ra-226)

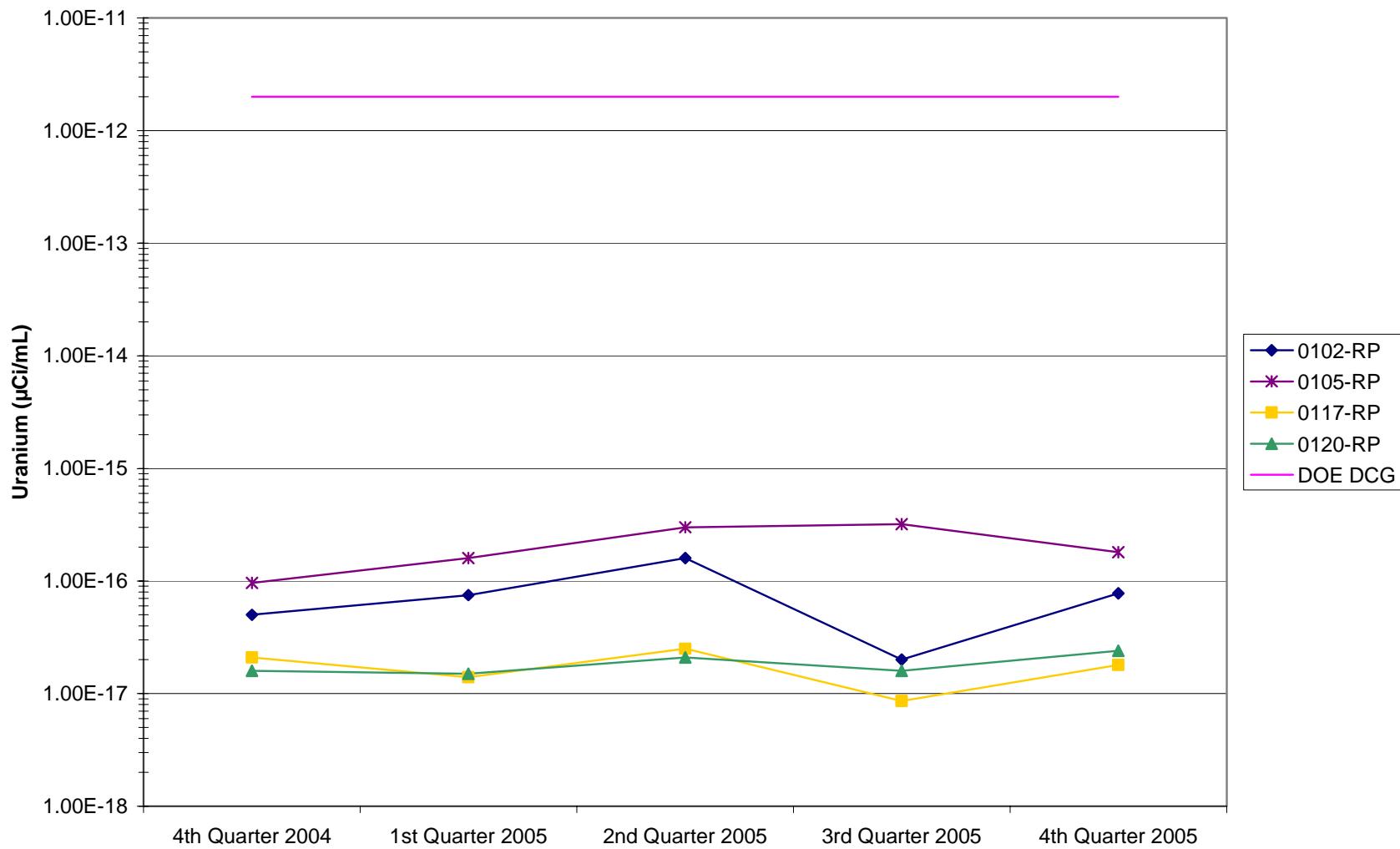


Figure 4. Moab Radioparticulate Concentration (Uranium)

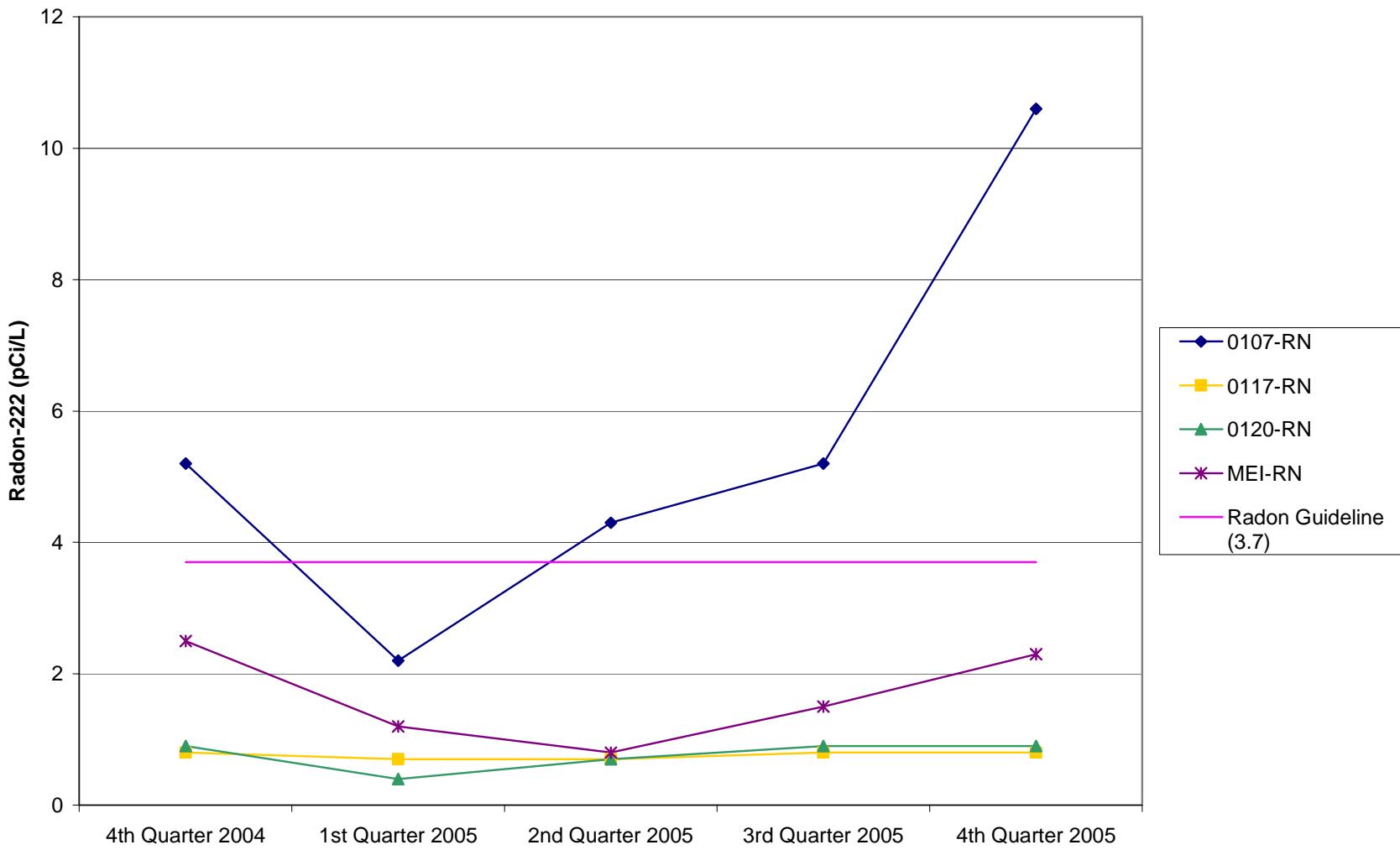


Figure 5. Moab Atmospheric Radon-222 Concentration

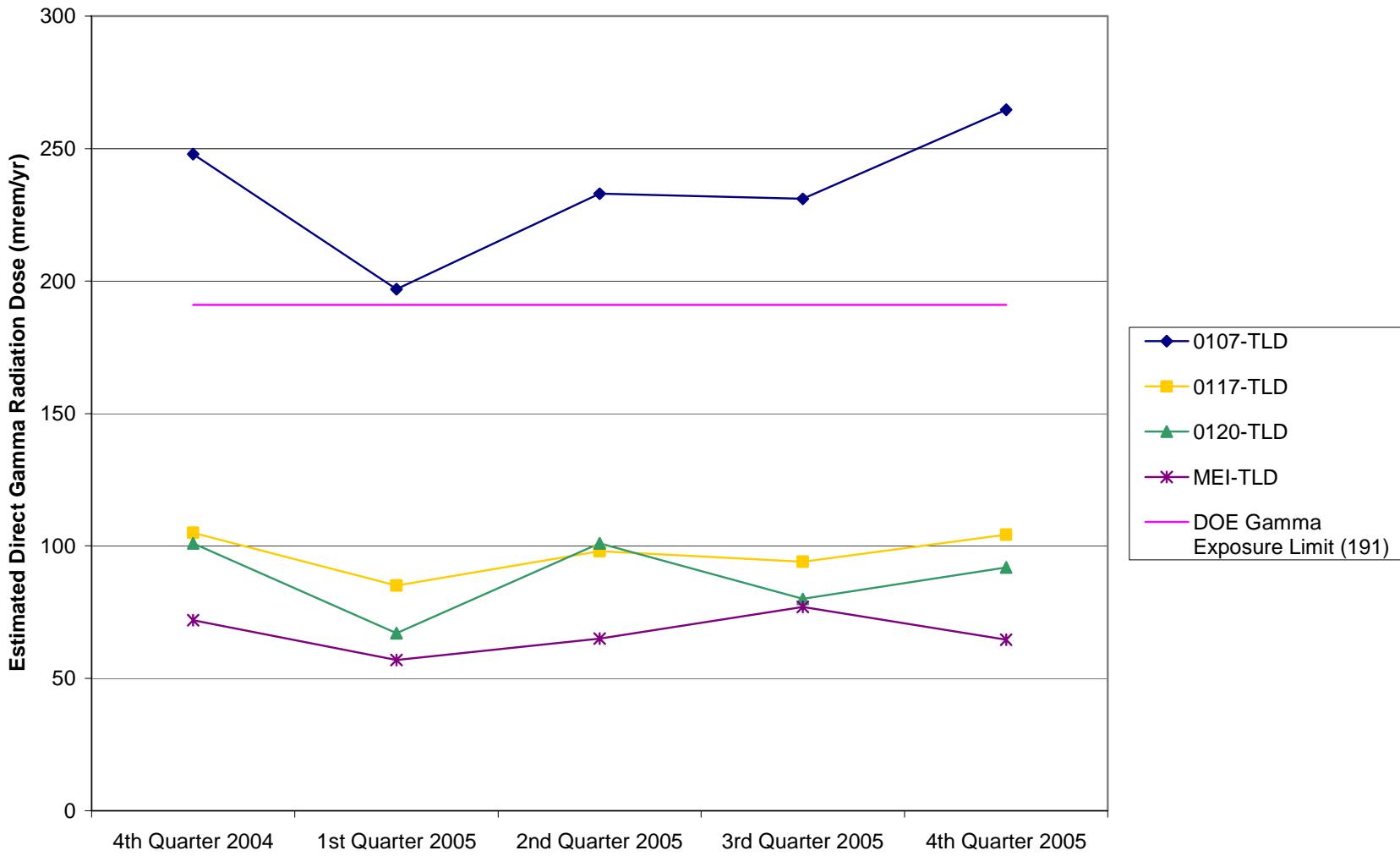


Figure 6. Moab Direct Gamma Radiation Dose

Sample Location Maps

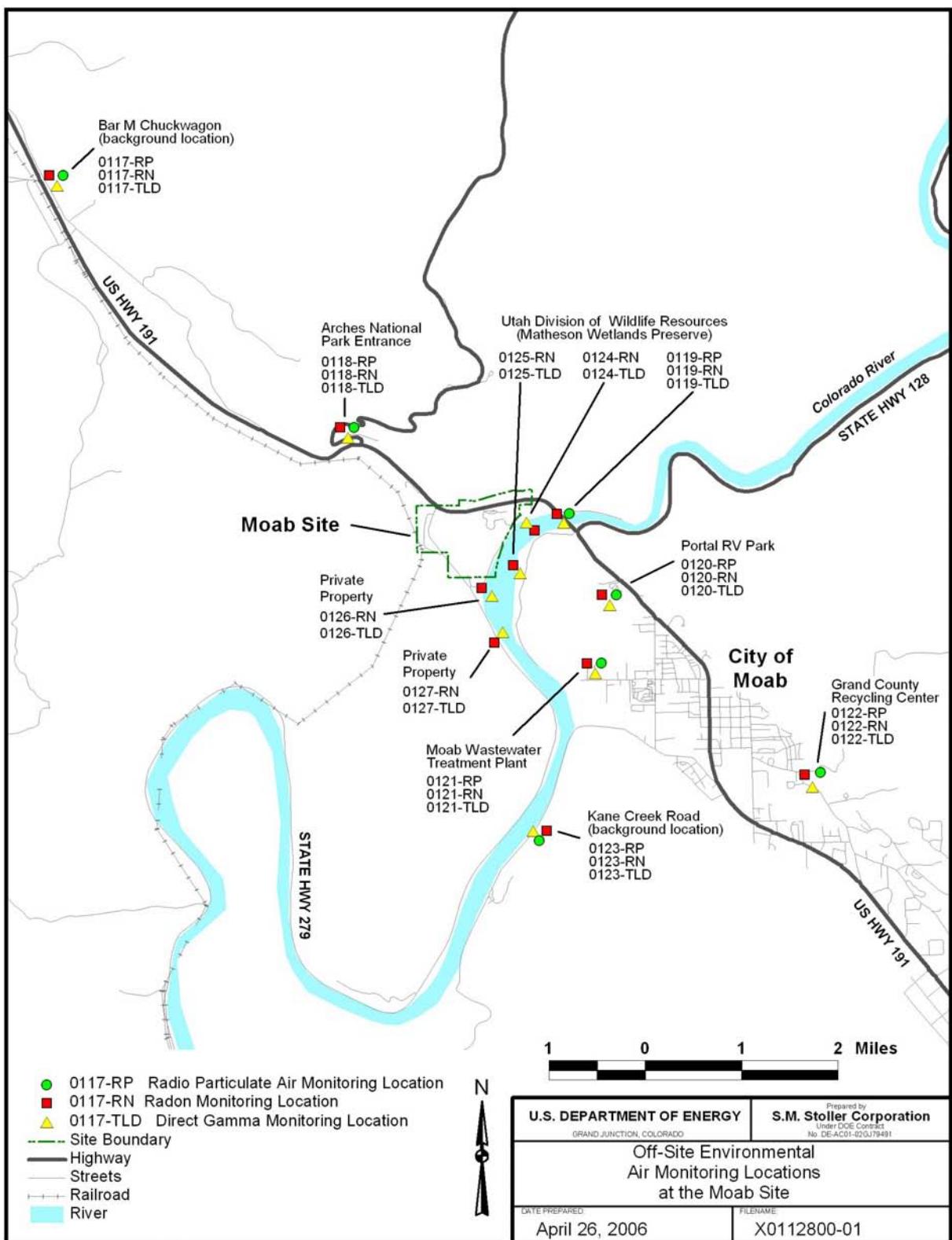


Figure 7. Off-site Radon, Direct Gamma, and Radioparticulate Monitoring Locations, 2005

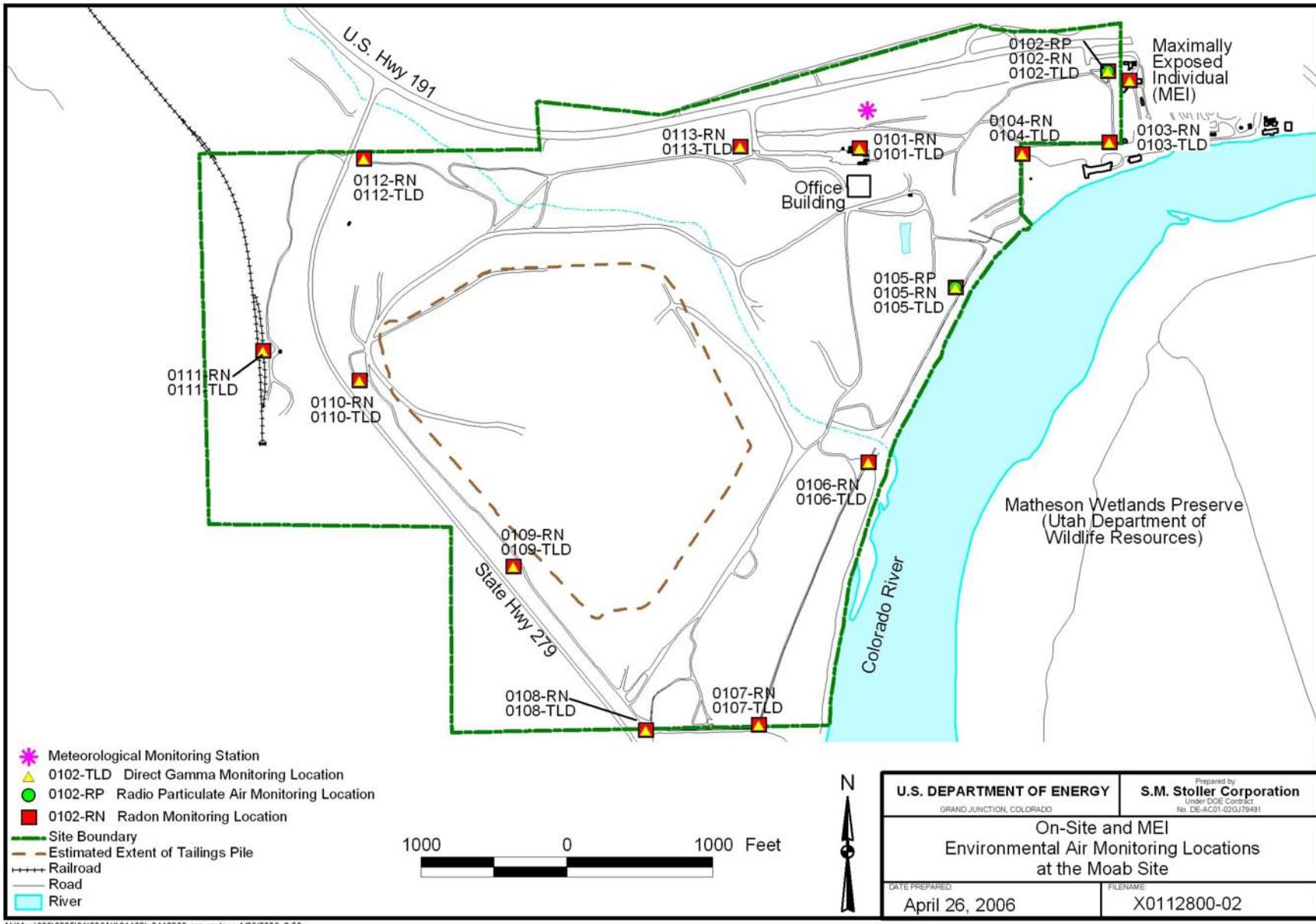


Figure 8. On-site Radon, Direct Gamma, and Radioparticulate Monitoring Locations, 2005